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ECOLOGY AND CONSERVATION OF OTTERS *(LUTRA LUTRA)* IN LOCH LOMOND AND THE TROSSACHS NATIONAL PARK

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ABSTRACT

Loch Lomond and The Trossachs National Park contains a diverse range of freshwaters and has adjacent coastal habitats suitable for otters (*Lutra lutra*) and their prey. Otters are found throughout the park and previous surveys suggest that they have recently reoccupied areas of their former range. Otters typically have home ranges containing at least 10 – 20 km of river, stream or loch. However due to variation in population density in different habitats it is not yet possible to estimate total population size. Otters feed on most species of fish present within the park and species taken is dependent on availability within different rivers and lochs. Eels are one of the principal prey due to their high energy content and amphibians are seasonally important. Specific requirements in freshwaters are for reed beds and islands for resting and breeding. The greatest threat to otters in the park at the present time is expected to be road mortality. Given the importance of agriculture within the park any potential effects of pollution on otters and their prey will be from pesticide use rather than from PCBs that are associated with industry. Disturbance to otters from anglers, walkers and dogs is thought to influence behaviour of animals only for short periods of time, however longer term effects of disturbance on breeding females and young is less well understood. Improvements in the status of otters within the park could be achieved by prevention of road mortalities, protection of breeding sites, habitat management for reed beds and riparian vegetation and long term monitoring of water quality and prey biomass.

INTRODUCTION

Scotland has remained a stronghold of the Eurasian otter (*Lutra lutra*) during its recent population decline in England and Wales (Chanin 2003). Although European otter populations are now recovering and expanding into previous parts of their range, the otter is a priority species in the UK biodiversity action plan (Joint Nature Conservancy Council 1994). The otter is listed on Appendix 1 of CITES, Appendix II of the Bern Convention and Annexes II and IV of the Habitats Directive. It is protected under Schedule 5 of the Wildlife and Countryside Act 1981 and Schedule 2 of the Conservation (Natural Habitats) Regulations 1994 (Regulation 38). The European sub-species is also listed as globally threatened on the IUCN / WCMC Red Data List.

There have been four national surveys examining the distribution of otters in Scotland in 1977-9, 1984-5, 1991-4 (Green & Green 1997) and 2003-4 (completed but unpublished) and several detailed studies on their biology and behaviour in the Shetlands (Kruuk 1995), Mull (Watt 1993), Isle of Skye (Yoxon 1999), Lochaber (Kruuk & Hewson 1978) and Argyll (McCluskie 1998). Otters occupying freshwater habitats have been examined in detail in NE Scotland on the catchments of the rivers Dee and Don (reviewed in Kruuk *et al.* 1998) and on the River Earn catchment in Perthshire (Green *et al.* 1984).

Loch Lomond and The Trossachs National Park contains a wide range of still and flowing fresh water systems that provide suitable habitat for otters and their prey. Still waters range from large deep lochs such as Loch Lomond (7100 ha) to numerous small hill lochs and artificial ponds. River systems are typically well oxygenated, low nutrient waters that predominantly contain fish from the salmonid family. There are also a number of fish populations within the park that are important prey of otters including eels (*Anguilla anguilla*) and cyprinids (Chanin 2003, LL&TNP Fish and Fisheries Forum 2004). Otters living in the park are not confined to freshwater systems as the boundary runs along 65 km (approximately 20 % of the 350 km park boundary) of coastline of three sheltered sea lochs.

The aim of this study was to examine the suitability of Loch Lomond and The Trossachs National Park for otters by providing:

1. a review of how otters use freshwater and marine habitats in Scotland,
2. a summary of available information on otters in the Loch Lomond and The Trossachs area
3. an outline of conservation priorities for otters in the national park

HABITAT USE BY OTTERS

Otters may occupy both freshwater and marine habitats within their home range and there are ecological differences in the way otters use these habitats (Table 1).

	Freshwater	Marine coastal
Main activity pattern	nocturnal (dawn & dusk)	diurnal
Foraging areas	still and flowing waters	Within 100 m coast
	marshland	
Mean dive depth and duration	< 2 m and <15 s (lochs)	< 2 m and < 20 s
Specific habitat preferences	reed beds and islands	freshwater pools or streams
Holt and rest sites	above ground (couches)	underground
	below ground	

Table 1. Differences in habitat use by freshwater and marine coastal otters. Summarised from Kruuk (1995, 1998).

Green *et al.* (1984) studied two females that occupied between 16 and 22 km while a male occupied 39 km of rivers, streams and lochs. In the river Dee and Don catchments there was a median estimate of one otter per 15 km of stream (Kruuk & Hewson 1978). In Shetland females have been recorded living in group ranges of 5 – 14 km of coast, males had larger ranges of up to 19 km overlapping with several group areas (Kruuk 1995). In this area there were on average 0.5 – 0.7 otters per km of coast. Expressed on an area basis these studies suggest that otters are found at densities in the order of one otter per 10 ha of water (Kruuk 1995). However this figure should be used with caution as estimates range between 2 and 50 ha.

Otters forage in a wide range of freshwaters including lochs, artificial lakes, marshland, rivers and particularly important are narrow streams with high prey biomass (Kruuk *et al.* 1998). Specific habitat requirements include reed beds and islands on lochs and rivers. These are required for resting and breeding sites but there appears to be no obvious correlation between otter distribution and vegetation cover (Kruuk *et al.* 1998, Thom *et al.* 1998). A variety of secluded sites below and above ground are used as holts, natal holts and couches for resting (Kruuk *et al.* 1998).

Otters occupy a range of coastal habitats in Scotland including both sheltered and exposed shorelines. The distribution of coastal dwelling otters is strongly associated with the occurrence of freshwater pools or streams, as this is an essential requirement for maintenance of healthy fur for thermoregulation. Holt sites are often underground below rocks or within peat banks (Kruuk 1995). In coastal areas otters are generally more active during daylight hours, while in freshwater most activity occurs at night, especially at dawn and dusk. This difference in behaviour is related to prey availability. Many marine prey are less active during the day, while in freshwater, some prey are least active at night. Foraging patterns of otters are also influenced by the tide, with otters in Shetland foraging least during high tide (Kruuk 1995). In coastal areas otters feed within 100 m of the coast, diving to depths not exceeding 10 m, with most dives within 2 m of the surface and lasting less than 20 seconds. In freshwater lochs otters dive to similar depths but for slightly shorter durations, averaging around 13 seconds and often coming ashore with prey (Conroy & Jenkins 1986). In both freshwater lochs and in the sea, otters concentrate their fishing effort in patches, diving and searching in a relatively small area of water before moving to new areas (Kruuk 1995). Otters forage in the margins of rivers and streams, avoiding the strongest current, and exploit shallow riffles when feeding on large salmonids (Carss *et al.* 1990). Marshland habitat is frequently used by otters, especially during spring when feeding on amphibians (Weber 1990).

Radio-tracking studies indicate that there is a difference between the use of freshwaters by males and females. Green *et al.* (1984) tracked two female and one male otter over several months. Within the home range of one female there was running water, still water and marshland but this animal spent 73 % of the time in one productive artificial lake. The second female had both running water and marshland within its home range and spent 72 % in the latter. In comparison the male occupied all three habitat types but spent 60 % of the time on the main river. In Deeside, adult males spent 62 % of their time on the main river while females and young males spent 87 % of the time on lochs and small tributaries (Kruuk *et al.* 1998). Habitat separation between male and female otters has also been recorded in coastal areas at certain times of the year (Kruuk 1995).

ECOLOGY OF OTTERS IN THE LOCH LOMOND AND THE TROSSACHS AREA

Habitat and distribution

Much of the information on otters living within the park is based on previous sign surveys (Green & Green 1997, McCafferty 2005) or anecdotal sightings of animals from members of the public, rangers and gamekeepers. The 1991-4 national survey recorded signs of otters in most freshwater systems within the geographical area of park and in the sea lochs bordering the park (Fig. 1). Nevertheless, future surveys of coastal areas are required to establish the importance of marine habitats for otters living within the park. The only known detailed study of otters undertaken within the geographical area of the park was by Green *et al* (1984). This study highlighted the importance of all freshwater habitats for otters within the upper Earn catchment.

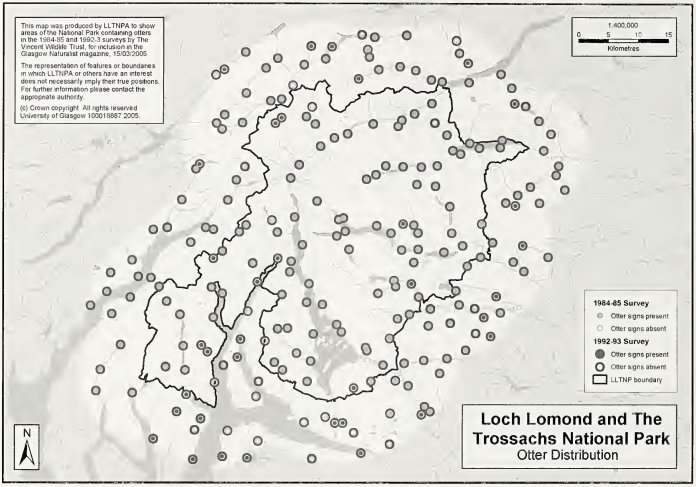

Fig 1. Distribution of otters within Loch Lomond and The Trossachs National Park as recorded by the Vincent Wildlife Trust's otter surveys of Scotland in the 1980s and 1990s.

Prey and diet

The diet of otters in the region of the park is similar to other freshwater areas of Britain, with fish dominating the diet and amphibians being particularly common during late winter and spring (Cameron 1981, Green *et al*, 1984, McCafferty, 2005). In the upper Earn catchment otters have been recorded feeding on *Salmo* spp., eels, cyprinids, perch (*Perca fluviatilis*), sticklebacks (*Gasterosteus aculeatus)*, amphibians as well as birds and mammals (Green *et al.* 1984). In Loch Lomond spraints also included ruffe (*Gymnocephalus cernuus)*, powan (*Coregonus lavaretus)*, northern pike (*Esox lucius)* and lampreys *(Lampetra* spp.) and changes in the diet were associated with the migration and spawning habits of a number of species (McCafferty, 2005). An analysis based on the recovery of otoliths (this study) indicated a similar pattern to that previously found. A total of 268 otoliths (59 %) were recovered from 453 spraints collected from Jan - Dec 2002 (see (McCafferty, 2005 for method of recovery). The frequency of occurrence was ruffe (52 %), cyprinids (51 %), eel (26 %), *Salmo* spp. (14 %), powan (4 %), pike (1.5 %) and perch (1.5 %). Both methods of diet analysis show that the most frequently occurring prey in spraints was the ruffe but there were small differences in the rank abundance of cyprinids and eel (Fig. 2).

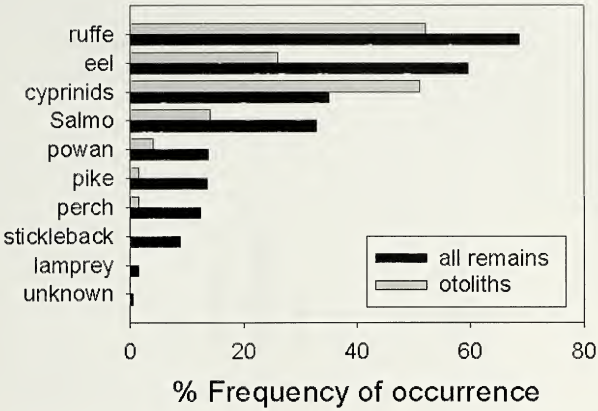

Fig 2. Frequency of occurrence of fish in otter spraints collected at Loch Lomond in 2002. Diet was determined by counting all remains in all spraints (n = 453) and also using the occurrence of otoliths only (n = 208).

The value of different prey for otters is not only dependent on their availability but also on their energy content. Ruffe have the lowest energy content (assuming similarity with perch in the same genus) whereas eel have the highest energy content of prey taken by otters (Table 2).

Fish group	Energy content kJg^{-1}	
Eel	6.08	(Norman 1963)
Brown trout	5.92	(Elliot 1976)
Cyprinids	4.82	(Beja 1996)
Vertebrate (non-fish)	4.69	(Beja 1996)
Perch	4.46	(Prévost 1982)

Table 2. Energy content of prey taken by otters.
Values are expressed as kJg^{-1} fresh body mass according to Beja (1996).

In Loch Lomond the average size of ruffe taken by otters was estimated to be 8.99 cm (range 2.49 – 15.40 mm (McCafferty, 2005) which represents an average body mass of 12.7 g (Adams & Tippett 1990). Based on the relationship between otolith width and eel body size the average length of eels taken by otters was estimated as 26.6 cm (SE = 12.8 n = 89 range 7.1 – 58.5 Fig. 3) or equivalent to 45.3 g (Martucci *et al.* 1993). This analysis indicates that the energy content of the average ruffe and eel taken by otters is 57 and 275 kJ respectively. Eels are therefore five times more profitable prey items than ruffe for otters in terms of their energy content. Freshwaters with high eel biomass are therefore key areas for otters within the park. Factors influencing eel distribution are not well understood but their abundance is thought to be greatest in still waters and otters do appear to specialise on them in these areas (Carss *et al.* 1998).

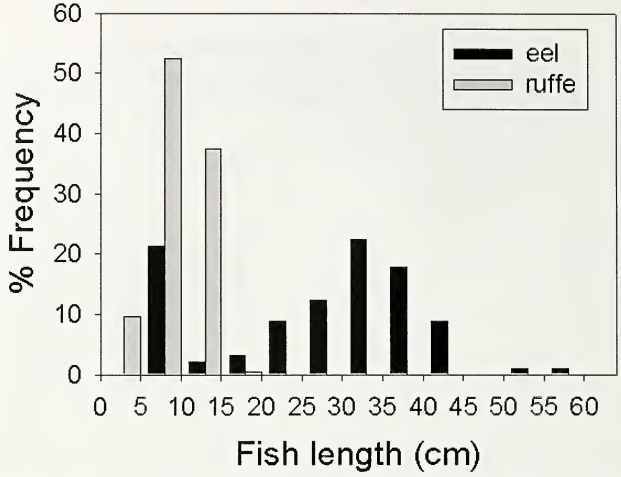

Fig 3. Comparison of the length (cm) of eel (n = 89) and ruffe (n= 208) taken by otters at Loch Lomond in 2002. Fish length was estimated using otolith size for both species (see text).

CONSERVATION PRIORITIES FOR OTTERS IN THE NATIONAL PARK

The UK Biodiversity action plan lists the current factors causing loss or decline of otters as 1. pollution of watercourses 2. insufficient prey associated with poor water quality, 3. impoverished bankside habitat features needed for breeding and resting and 4. incidental mortality, primarily by road deaths and drowning in eel traps (www.ukbap.org.uk). The opportunity of improving the conservation status of otters within the park should address each of these issues but as outlined below some of these require greater priority (Table 3). Currently, the otter is registered as an Annex II species (present as a qualifying feature, but not a primary reason for site selection) in the designation of the Loch Lomond Woods Special Area of Conservation.

	Short term	Medium term	Long term
Road mortality survey and mitigation	√	√	
Breeding records and monitoring		√	√
Habitat management		√	√
Distribution survey			√
Water quality monitoring			√
Fish biomass surveys			√

Table 3. Suggested short, medium and long term conservation objectives for otters in Loch Lomond and The Trossachs National Park.

Pollution and water quality

Although there is some controversy over the most important pollutant affecting otter populations, contamination with PCBs and / or organochlorine pesticide residues is considered the most likely cause of the widespread decline of otters in Europe (Mason & Macdonald 1986; Mason *et al.*

1992). The main source of PCBs comes from the manufacture and disposal of electrical components. Given the lack of industry within the park there are likely to be no major sources of PCBs for otters. In 1990-1 relatively high levels of PCBs were however recorded in otter spraints collected in Loch Long (Mason *et al.* 1992). The nearest source of PCBs may therefore come from adjacent marine habitats that are associated with shipping and naval activities.

Pesticides including Lindane, Dieldrin and DDT (and its metabolites) were also recorded in spraints within the vicinity of the park in the early 1990s (Mason *et al.* 1992). Given that land use within the park is predominantly for agriculture and forestry, pesticides and their residues are likely to enter freshwater systems. Dieldrin, Aldrin, Endrin, DDT and DDE were recorded in the river Leven at Renton footbridge between 2000 and 2003 (Scottish Environmental Protection Agency Harmonised Monitoring Data www.sepa.org.uk). Although the concentrations recorded were extremely low it does highlight that these compounds are present in the environment. No other pesticides have been directly linked to otter declines but the increased use of pyrethroid compounds in sheep dips may have indirect effects on otters due to a reduction in fish that have lost their invertebrate food supply (Chanin 2003). Sheep farming is widely carried out within the park and therefore any reduction in fish populations (especially eels) as a result of pesticide discharge will have an impact on otter populations.

The minimum fish biomass required to support viable otter populations in freshwater habitats is estimated to be around 10 gm^{-2} (Chanin, 2003). There appear to be no suitable data within the park to examine how otter distribution is determined by prey abundance. A small tributary of the river Almond in Perthshire close to the northern boundary of the park contained a salmonid biomass of 16.8 – 22.9 gm^{-2} (Egglishaw 1970) and salmonid and eel biomasses of 9.2 – 14.4 gm^{-2} and 0.5 – 1.6 gm^{-2}, respectively were recorded in similar oligotrophic streams in NE Scotland (Kruuk *et al.* 1993). In the long term, monitoring of fish biomass and water quality would improve our understanding of otter distribution in the park.

Habitat

The national otter surveys successfully sampled a range of habitats, and otter sites were well distributed throughout the geographical area of the park. This is a valuable long term data set for monitoring purposes and these should be continued in future years. A survey repeated each decade is probably sufficient to record long term population trends. More important may be the monitoring of how different habitats are used by otters and ways to improve their suitability. In particular, bankside vegetation and reed beds are important habitats for resting and breeding (Kruuk *et al.* 1998). The protection of these habitats or preferably an increase in the area of reed beds would have beneficial effects for otters.

Road mortalities and eel trapping

Given the extensive network of roads within the park it is likely that vehicles will kill many otters. A recent study by Green (In press) recorded 50 otter deaths on 156 km of the A75 over 12 months or equivalent to 1 death per 3.12 km per year. Main roads with large volumes of traffic account for a high mortality of otters throughout the UK (Philcox *et al.* 1999). Road mortality is greatest during periods of high river flow that cause otters to travel overland. Given that the park has more than 600 km of roads, including five main trunk roads it is expected that this will be the major human impact on otter populations within the park. A road mortality monitoring scheme is required to determine the extent of the problem and identify areas where changes to design of bridges or culverts is needed.

Although eels have been commercially fished in Loch Lomond and river Endrick, incidental mortality from by-catch in eel traps is expected to be low as the trapping of eels is scarce today (Mitchell 2001).

Disturbance

The national park is an important area for recreation and tourism and therefore what is the effect of human disturbance on otters? Chanin (2003) recently concluded that the recovery of the otter population is not being influenced by human disturbance and anecdotal evidence suggests that otters are not seriously affected by disturbance from anglers, walkers and dogs. Otters do not appear to avoid houses, industry, roads, campsites and much of the mess left by people (Kruuk 1995). The response of otters to the sounds of anglers or walkers with dogs is for otters to move to a position where they can see the source of disturbance, dive and swim underwater, then resurface and rest on the bank before resuming their previous activity a short while later (Durbin 1993). Green *et al.* (1984) also noted that that otters passed fisherman by land, underwater or through dense vegetation and then continued their activities.

Although individual otters do not appear to be influenced by short periods of disturbance there is a lack of information on how sustained levels of disturbance influences female otters with young. This may be particularly relevant in areas such as Loch Lomond where there is a high level of disturbance at certain times of the year. A main priority will be to identify breeding sites and monitor breeding success of otters to assess the effects of disturbance in different areas.

SUMMARY

Loch Lomond and The Trossachs National Park contains a diverse range of freshwaters and has adjacent marine coastal habitats suitable for otters and their prey. Otters appear to be widely distributed throughout the park and previous surveys suggest that they have reoccupied areas of their former range. The main conflict with humans within the park is likely to be as a result of road mortality. There is therefore a need to identify where road casualties occur so that measures can be implemented to reduce them. Monitoring of otter breeding sites is required to safeguard sites from habitat change or possible disturbance to females with young. Management is recommended to increase the area of important reed bed habitat for breeding and rest sites. Finally our understanding of otter distribution within the park would be improved by collecting data on fish biomass and water quality.

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